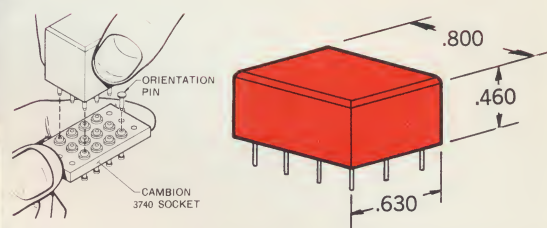


D I G I T A L MODULES

CAMBRIDGE THERMIONIC CORPORATION
CAMBION®

CATALOG NO. 82

SILICON 2 MEGACYCLE DIGITAL MODULES



Cambion announces the availability of a NEW line of plug-in digital modules. This is a **silicon line** which enables high temperature operation (up to 125° C) at a faster speed (2 MC clock rate) and with power drain only one-fifth that of 100 KC germanium lines of conventional modules.

Modules in the silicon line use the same pins, configurations, color coding and nomenclature as the standard germanium line. Thus, the same mounting hardware (sockets, printed circuit cards, etc.) can be used.

The silicon line is particularly suitable for **positive logic**, although negative logic is also conveniently usable. **Nomenclature** on the silicon line follows the same pattern as the germanium line, except the first number is changed from 1 to 2 for identification purposes, e.g.,

FF-11-1	(Flip Flop in Germanium line)
FF-21-1	(Flip Flop in Silicon line)

Following are some of the IMPORTANT FEATURES of the new silicon line:

1. 2 MC operation.
2. -35°C to +125°C operation.
3. Lower power drain (typical Flip-Flop takes about 4 mA of current).
4. 12-pin structure enabling more functions per module. Usable on printed circuits as well as in sockets.
5. Logic function flexible from +6V to +12V, depending upon application. Bias voltage is correspondingly in between -6V to -12V.
6. **Height less than 1/2"**. This enables convenient and complete use of chassis stacks when these modules are mounted on printed circuit cards. Dimensions: L — .800", W — .630", H — .460".
7. Molded in epoxy.
8. .200" grid configuration.
9. Particularly suitable for positive logic, although negative logic can be used.
10. Availability of all the logic types of germanium line modules, plus additional types such as Positive-Negative Logic Converter and Negative-Positive Logic Converter. Thus, **hybrid Positive-Negative logic** can be synthesized, leading to system optimization.

MECHANICAL CHARACTERISTICS

These modules measure .460" high (including pins), by .800" long, by .630" wide and are encapsulated in epoxy. The modules have functional shape and finish and can be duplicated uniformly at a high rate of production, thus minimizing their cost. The finished modules are evenly impregnated, hard and resistant to chipping. In addition to color coding, the function is imprinted on each module.

On the bottom side of the module, pin numbers are imprinted to avoid any confusion during printed circuit or socket connection.

The standard .200" grid configuration of the module pins (diameter .025") permits interconnections to be made more directly (and hence more economically), more densely and with shorter signal paths. The pins are of gold plated half-hard brass to resist deformation, to mount easily in printed circuit boards (or in specially designed jacks also available from CAMBION), and for long shelf life. Vapor trap lands are staggered between the pins to prevent moisture collection.

ENVIRONMENTAL

Temperature (Operating)	-35°C to +125°C
Temperature (Storage)	-65°C to +150°C
Vibration	±20g 30 to 2000cps
Mounting	Any position
Shock	50g, per MIL-STD-202B, Method 205B Condition B
Altitude:	100,000 ft. operating
Humidity:	10 days per MIL-STD-202B, Method 160A (95-98%)
Immersion:	Cycling per MIL-STD-202B, Method 104A Test Condition C

TOTAL TYPES AVAILABLE

The following families of logic modules are available:

Flip-Flop (4 Types)	Complementary Emitter Follower
Inverter (3 Types)	One Shot Generator (Delay Multivibrator)
AND Gates (7 Types)	Level Trigger
OR Gate (7 Types)	Clock
NAND Amplifier (2 Types)	Exclusive-Or
NOR Amplifier (2 Types)	Light Driver
Buffer Amplifier	Adder-Subtractor
Positive Buffer Amplifier	Relay Driver
Emitter Follower	Positive-Negative Logic Converter
Negative Emitter Follower	Negative-Positive Logic Converter

Additional modules such as Nixie Driver, 1 Amp Relay Driver, are available manufactured to order.

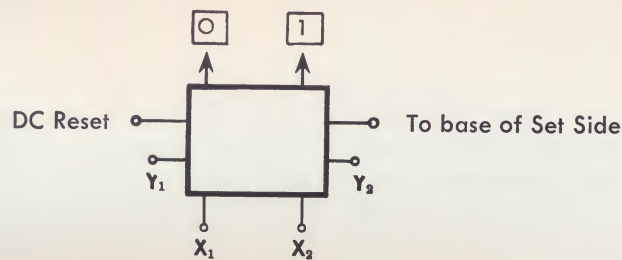
SPECIAL MODULES

Special modules to supplement the standard modules can be made to customer's specifications.

GENERAL DESCRIPTION AND APPLICATION OF 2 MC SILICON MODULES

FLIP FLOP

The silicon 2 MC line has 4 types of Flip Flops which are the same in configuration as the 100 KC germanium line, except for polarities. All Flip Flops have DC reset ($-3V$ to $-12V$ DC operating pulse, current limited through diode not to exceed 100mA). The base side of the Set side of the Flip Flop is also available, thus enabling additional logic connections to be made to the Flip Flop. The set, reset or trigger side of the FF is actuated by the trailing edge (fall part) of a positive pulse. The magnitude should be between $+6V$ to $+12V$ and fall time smaller than $.1 \mu\text{sec}$. The output of the Flip Flop is a level change of Gnd to $+9V$ with a fall time of better than 40 nsec. in unloaded condition.



FF-21-1 (Universal Type)

- (a) For Counter and Trigger Mode applications, Y_1 and Y_2 are connected to "0" and "1" sides of the Flip-Flop respectively while X_1 and X_2 are connected to a common terminal X. This is the same configuration as the FF-21-3 type.

$$\text{Logic equation is: } Q(t + \delta) = Q(t) \oplus X(t)$$

- (b) For Storage and Shift Register applications Y_1 and Y_2 are connected to the "0" and "1" side respectively, but X_1 and X_2 are independent. This is the same configuration as FF-21-4.

$$\begin{aligned} \text{Logic equations are: } Q(t + \delta) &= \bar{Q}(t)X_2(t) + Q(t)\bar{X}_1(t) \\ X_1X_2 &= 0 \end{aligned}$$

- (c) For Shift Register application, Y_1 and Y_2 are independent while X_1 and X_2 are connected together.

$$\begin{aligned} \text{Logic equations are: } Q(t + \delta) &= Y_1(t) \bar{Y}_2(t) X(t) \\ Y_1 + Y_2 &= 1 \text{ (at clock time)} \end{aligned}$$

FF-21-2

Same as above except X_1 and X_2 are connected together.

The logic equations for this Flip-Flop are:

$$\begin{aligned} Q(t + \delta) &= Y_1(t) \bar{Y}_2(t) X(t) \\ Y_1(t) + Y_2(t) &= 1 \text{ (at clock time)} \end{aligned}$$

L \rightarrow R Shifting is achieved by connecting Y_1 to the "1" side of the previous Flip-Flop.

FF-21-3

Same as Universal Type except connections are internally made for Counter and Trigger mode applications.

$$\text{The logic equation is: } Q(t + \delta) = Q(t) \oplus X(t)$$

FF-21-4

Same as Universal Type except X_1 and X_2 are separate while Y_1 is connected to "0" side and Y_2 is connected to "1" side.

$$\begin{aligned} \text{The logic equations are: } Q(t + \delta) &= \bar{Q}(t)X_2(t) + Q(t)\bar{X}_1(t) \\ X_1X_2 &= 0 \end{aligned}$$

LEVEL TRIGGER

LT-21-1 is used for pulse shape restoration. The module accepts slow and distorted wave forms (down to DC) and generates high speed rectangular pulses at the same frequency. An additional voltage is needed for $+3V$ to $+6V$ which can be varied to adjust the threshold at which generation of the pulse is required. Thus the circuit has adjustable noise rejection capability. From logic point of view, the output is the same as the input. Output is $+12V$ with fall time better than 40 nsec. and rise time better than $.15 \mu\text{sec}$.

BUFFER AMPLIFIER

BA-21-1 is logically neutral and is used to enhance the drive capability of the falling signal (Positive to to Ground transition).

POSITIVE BUFFER AMPLIFIER

PB-21-1 is logically neutral and is used to enhance the drive capability for a rising signal. In static condition it provides current drive capability during the $+12V$ state.

INVERTERS

IN-21-1 The output is inverted with respect to input. Input amplitude should be $+6V$ or higher.

IN-22-1 has two of the above inverters in each module.

IN-22-2 is the same as IN-21-1 except the collector resistors are not connected and can be connected outside.

AND GATES

There are 7 types of single and multiple function AND gates. This choice enables one to use the right type of module, resulting in economy and convenience. Input magnitude should be Gnd for logical "0" and between $+8V$ to $+12V$ for logical "1".

Logical Equations for the various AND gates are as follows:—

AG-21-1	$F = A.B.C$	(Single AND gate with three inputs)
AG-21-2	$F = A.B.C.D.E$	(Single AND gate with five inputs)
AG-21-3	$F = A.B.C.D.E.G.H.I.J$	(Single AND gate with nine inputs)
AG-22-1	$F_1 = A.B$ $F_2 = C.D$	(Dual AND gates, each with two inputs)
AG-22-2	$F_1 = A.B.C.D$ $F_2 = E.F.G.H$	(Dual AND gate, each with 4 inputs)
AG-23-1	$F_1 = A.B$ $F_2 = C.D$ $F_3 = E.F$	(Triple AND gate, each with 2 inputs)
AG-24-1	$F_1 = A.B$ $F_3 = D.E$ $F_2 = B.C$ $F_4 = E.F$	(Quadruple AND gates, each with 2 inputs, one of which is common to two AND gates)

OR GATES

There are 7 types of OR gates. Gnd is logical "0" and +8V to +12V is logical "1". Logical equations for the various OR gates are as follows:

OG-21-1	$F = A + B + C$	(Single OR gate with 3 inputs)
OG-21-2	$F = A + B + C + D + E$	(Single OR gate with 5 inputs)
OG-21-3	$F = A + B + C + D + E + G + H + I + J$	(Single OR gate with 9 inputs)
OG-22-1	$F_1 = A + B$ $F_2 = C + D$	(Dual OR gates, each with 2 inputs)
OG-22-2	$F_1 = A + B + C + D$ $F_2 = E + F + G + H$	(Dual OR gates, each with 4 inputs)
OG-23-1	$F_1 = A + B$ $F_2 = C + D$ $F_3 = E + F$	(Triple OR gates, each with 2 inputs)
OG-24-1	$F_1 = A + B$ $F_2 = B + C$ $F_3 = D + E$ $F_4 = E + F$	(Quadruple OR gates, each with 2 inputs, one of which is common to two OR gates)

NAND GATE

NA-21-1

Input should have Gnd for logical "0" and +6V to +12V for logical "1". Output is +12V and Gnd, with t_r less than 40 nsec. and t_f less than 150 nsec. For inputs A, B, C the output is $F = \overline{A.B.C}$

NA-21-2 is the same as NA-21-1 except it has 6 inputs. On both these modules, additional external diodes can be connected at pin 7 to increase the number of inputs. For inputs A B C D E G, the output is $F = \overline{A.B.C.D.E.G}$

NOR GATE

NO-21-1 Input for the module is Ground for logical "0" and +8V to +12V for logical "1".

For inputs A, B, C the output is $F = \overline{A + B + C}$

NO-21-2 is the same as NO-21-1 except it has 6 inputs. On both these modules, additional external diodes can be connected at pin 1 to increase the number of inputs. For inputs A, B, C, D, E, G the output is $F = \overline{A + B + C + D + E + G}$

EMITTER FOLLOWERS

EF-22-1 There are two emitter followers in this module to enhance the drive capability during the positive swing. Output is the same as input in rise time and in amplitude (except for a small diode drop).

CF-21-1 is a complementary emitter follower which enables the output to be the same as the input both in rise and fall times and magnitude.

NF-22-1 is a negative emitter follower for negative swings, i.e., +12V to Gnd. Here the output fall time is the same as the input. There are two such functions in a module.

ONE SHOT GENERATOR

OS-21-1 generates one shot pulse when triggered by the falling part of an input wave form. Input should have amplitude of +6V to +12V with a fall time less than .2 μ sec.

CLOCK GENERATOR

CG-21-1 is a free running RC clock, the frequency of which can be varied by means of external capacitors and precise adjustments for frequency can be done by an external potentiometer.

Frequencies up to 5 MC can be generated by this clock. Operation of the clock is inhibited by applying Ground to pin 9. (This clamps the collector of one side of the clock. Thus the clock can be logically controlled.)

EXCLUSIVE-OR

EO-21-1 needs inputs A and B with logical "0" at Gnd and logical "1" at +8V to +12V. The output is $AB + \bar{A}\bar{B}$ with a magnitude of +12V and Gnd, and fall time better than 100 nsec.

ADDER-SUBTRACTER

AS-21-1 can be used to generate sum or difference of two digits and the ensuing carry or borrow. This is same as Exclusive-Or except it has an additional AND gate.

LIGHT DRIVER

LD-22-1 can supply up to 80 mA of current in Gnd state to the light bulb. Input amplitude should be Gnd to turn off the bulb and +6V to +12V to turn it on. There are two functions in this module.

RELAY DRIVER

RD-22-1 can supply up to 80 mA of current in Gnd state. An internal diode is used to quench induced voltages. There are two functions in this module.

LOGIC CONVERTERS

PN-22-1 Logic Converter is used to convert positive logic into negative logic. Basically it converts +12V or less (up to +6V) at input into -12V at output, while Gnd level at input maintains a Ground level at output.

NP-22-1 Logic Converter is used to do the reverse of above. Input at -12V or less (up to -6V) is converted into +12V, while Gnd level at input maintains a Gnd level at output.

POWER AND LOGIC CONNECTIONS

All modules, with the exception of AND, OR, gates have the following standard Power connections

+V Pin 10		-V Pin 2,		Gnd Pin 5	
Flip-Flops		LT	BA, PB	IN, EF, LD RD, NF	NA, NO 21-1
X ₁ 3 X ₂ 8 '1' Side output 6 DC reset 1	Y ₁ 4 Y ₂ 7 '0' side output 11 base set side 9	Input at 3 Output at 6 +ve Ref Voltage at 4	Input at 3 Inverted output at 6 Proper output at 11, in addition, only PB re- quires +ve Ref Volt- age at Pin 4.	Input at 3 Output at 6 Input at 8 Output at 11	Inputs at 1, 3, 9 Pin 7 for additional in- puts for NA and Pin 8 for NO Output at 6
CF, PN, NP	OS (One Shot)	CG (Clock)		EO, AS	NA, NO, 21-2
Input at 3 Output at 6	Capacitor adder be- tween Pin 9 and 6 Resistor adder between 1 and 2 Input at 3, Output at 11 Inverted Output at 6	Capacitor adder be- tween 6 and 3, and be- tween 11 and 8. Inhibit diode at Pin 9 clamps output at Pin 11 to Gnd, other output at 6.		A at 3 B at 8 $A \oplus B$ at 1 AB at 9 In AS only A.B at Pin 7	Same as NA, NO 21-1 except it has additional inputs at Pin 4, 11, 12

AND, OR Gates

Because of the large variety of AND, OR gates available it has not been possible to include the pin connections for these gates. Such information is enclosed with the shipment of modules as well as available for all modules on a separate sheet on asking us. As a general guideline it may be noted that the modules follow very much the same logic pin connections as corresponding modules of 100 KC line as shown in Cambion Catalog 80.

DRIVE TABLE FOR +12 VOLT LOGIC

DRIVER	LOAD															
	FF	IN	AG	OG	NA	NO	BA	PB	EF	NF	CF	OS	LT	EO	AS	LD
FF	3	4	8	4	8	2	3	3	6	4	4	2	3	3	2	6 π
IN	6	4	8	4	6	3	3	3	4	3	3	3	3	3	4	6 π
AG	6	6	5	4	6	3	3	2	4	4	3	3	3	2	2	5 π
OG	6 Δ	3	(+)	5	6*§	§ λ 6 π	3	3	6	3	5	6 λ 6 Δ	(+)	6	6 Δ	8 π
NA	6	7	8	5	3	3	4	2	6	4	4	6	3	3	4	5 π
NO	6	7	6	5	3	3	3	2	6	4	4	5	3	3	3	5 π
BA	6	8	8	6	4	4	3	4	6	4	4	5	6	3	2	6 π
PB	(+)	3	2	5	1	5	1	2	6	3	3	(+)	(+)	4	2	8 π
EF	(+)	8	(+)	8	4 Δ	6	1	3	7	3	3	(+)	2	4	5 Δ	8
NF	3	1	8	1	6	(+)	(+)	1	2	6	2	4	1	1	1	6 π
CF	8	8	8	8	8	8	6	5	8	8	8	4	8	8	6	8
OS	2	3	4	3	4	1	2	2	3	3	3	1	4	2	3	6 π
LT	6	4	6 λ	5	5	1	3	2	5	5	5	4	5	3	1	7 π
CG	4	1	2	2	5	1	1	1	6	5	5	3	5	2	2	6 π
EO	6 Δ	5 π	8 λ 6 Δ	2	§ Δ 6 Δ	1	1	2	4	4	4	5 Δ	5 Δ	3	5 Δ	5 π
AS	6 Δ	2	6 λ 6 Δ	3 Δ	6 Δ	6 π	7 Δ	2	4	4	3	4 Δ	6 Δ	2	4 Δ	5 π

Δ BA as Intermediate Driver
* PB as Intermediate Driver

§ CF as Intermediate Driver
 π EF as Intermediate Driver

λ NF as Intermediate Driver
(+) Not Supposed to Drive

MOUNTING HARDWARE FOR CAMBION 12-PIN LOGIC MODULES

PRINTED CIRCUIT CARDS (5.688" \times 6.344" \times .062") (Part Nos. 3421 and 3453)

This universal printed circuit card provides sockets for 16 digital logic modules. A common printed wiring buss is provided for the supply voltages and ground. This is available in two types, one with jacks on the reverse for patch cord connections (3421), and the other with terminals on the back for soldered connections (3453). A handle is provided on one end of the card, and a 32-pin output, suitable to plug into a 32-pin printed circuit connector, is available on the other end of the card. This card is convenient for large and small systems and can be used in standard mounting hardware chassis.

PHENOLIC MODULE BOARDS (4" \times 4" \times .187") (Part Nos. 1746 and 1747)

When the design calls for prototype work or smaller systems, this board is recommended. It provides you with 12 built-in sockets which accept Cambion modules on one side and Cambion patch cords on the reverse side for programming (1746). Also available is a similar board with turret terminals on the reverse side for soldered connections (1747).

SPECIAL PHENOLIC BOARDS WITH BUILT-IN SOCKETS SUITABLE FOR RACK MOUNTING

Cambion can supply $\frac{1}{8}$ " or $\frac{3}{16}$ " thickness phenolic boards with built-in sockets of either the patch-cord-type jacks on the back or the turret terminals. Vertical stacking in the board can be supplied in multiples of 3 for a maximum of 120, while horizontal stacking can be made from 1 to 24. These boards can be made from glass epoxy or other material specified by the customer, with a corresponding change in price.

STANDARD 19" PHENOLIC BOARDS WITH BUILT-IN

SOCKETS SUITABLE FOR RACK MOUNTING (19" \times 5.188" \times .125") (Part Nos. 1722 and 1723)

Two standard type boards are available with facilities for mounting 65 sockets on each board. Here again, this board is available in two versions, one with jacks on the reverse side for patch cord connections (1722), and the other with turret terminals for soldered connections (1723).

STANDARD REMOVABLE SOCKETS (Part Nos. 3469, 3740 and 3741)

Single removable sockets made of paper base phenolic (thickness $\frac{1}{8}$ ") are available both in jack (3741) as well as terminal (3740) types. They may be mounted on top or bottom of chassis. Another version of a single socket, molded in diallyl phthalate (3469), is available. This can be mounted below the chassis through a rectangular hole. Tools for punching rectangular holes are available (Part No. 3895).

MODULE PIN STRAIGHTENER (Part No. 2878)

A module pin straightener is available to ensure that proper pin alignment is maintained. Customers may mount one of these straighteners on each system rack or cabinet for convenience.

MODULE PULLER (Part No. 2876)

In applications where the logic modules have been mounted close together to achieve hi-packaging densities, the modules may be conveniently removed by using a Cambion module puller. Further, use of module puller prevents bending of pins.

PATCH CORDS (Part No. 3300)

Patch cords with piggy-back jacks are available in standard sizes of 2", 4", 6", 8", and 12" and in three standard colors; other colors are available assembled to order.

100 KC GERMANIUM MODULES

(.800" x .630" x .770")

This complete line of 42 types of 12-Pin modules, has the same grid configuration (.200") and uses the same mounting hardware as 2 MC line. This line is designed for Industrial Digital Systems, Process Control Computers, Digital Communication and Data Processing applications where switching speed is secondary to considerations of economy, simplified circuitry, ease of mounting, and straightforward connections. For complete information on this line, ask us for Catalog 80.

10 MC GERMANIUM MODULES

10 MC germanium modules are available in 7-Pin tube structure and in 12-Pin, .200" grid configuration.

APPLICATIONS ASSISTANCE AND SYSTEMS ENGINEERING

Cambion Digital Engineers are available to discuss and assist customers regarding logic implementation and systems engineering aspects of applications. Our applications and system design group will assist customers in designing these versatile modules into efficient, low-cost systems for a wide variety of modern digital logic applications.

CUSTOMER SERVICE IN DESIGN AND FABRICATION OF DIGITAL SYSTEMS

In addition to providing modules for customer applications, Cambion will be glad to quote on the design and fabrication of Complete Digital Systems using Cambion modules. This service will be of assistance to customers who may prefer to procure systems and who may wish to take advantage of Cambion's extensive facilities.

HOW TO ORDER CAMBION DIGITAL MODULES

When ordering, specify type module and description. For example: FF-21-2, Flip Flop. LT-21-1, Level Trigger. Price list furnished upon request.

GUARANTEE: Like all CAMBION components, digital modules are guaranteed.

Printed in U.S.A.